CLAIMS

1. A photonic crystal fibre comprising a bulk material having an arrangement of longitudinal holes and a guiding core, wherein the fibre has at-most-two-fold rotational symmetry about a longitudinal axis and as a result of that lack of symmetry, the fibre is birefringent.

2. A photonic crystal fibre as claimed in claim 1, in which the arrangement of holes is substantially periodic except for the presence of the core.

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3. A photonic crystal fibre as claimed in claim 1 or claim 2, in which the birefringence is such that light with a wavelength of 1.5 microns propagating in the fibre has a beat length of less than 5 mm.

B

4. A photonic crystal fibre as claimed in any preceding claim, in which the fibre has two-fold rotational symmetry.

5. A photonic crystal fibre as claimed in any preceding claim, in which the rotational symmetry is about an axis passing through the core.

SUB A17

6. A photonic crystal fibre as claimed in any of claims 1 to 5, in which the core includes a hole.

A

7. A photonic crystal fibre as claimed in claim 6, in which the hole is filled with material other than air.

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8. A photonic crystal fibre as claimed in any of claims 1 to 5, in which the core does not include a hole.

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9. A photonic crystal fibre as claimed in any preceding claim, in which the arrangement of holes has at-most-two-fold rotational symmetry about an

axis parallel to the longitudinal axis of the fibre.

10. A photonic crystal fibre as claimed in any of claims 1 to 8, in which the arrangement of holes has higher-than-two-fold rotational symmetry about an axis parallel to the longitudinal axis of the fibre.

Sub B2 cont.

11. A photonic crystal fibre as claimed in any preceding claim, in which the lack of higher rotational symmetry at least partly results from a variation, across the cross-section of the fibre, in the microstructure of the core.

12. A photonic crystal fibre as claimed in any preceding claim, in which the lack of higher rotational symmetry at least partly results from a variation, across the cross-section of the fibre, in the diameter of the holes.

13. A photonic crystal fibre as claimed in any preceding claim, in which the lack of higher rotational symmetry at least partly results from a variation, across the cross-section of the fibre, in the bulk material.

14. A photonic crystal fibre as claimed in any preceding claim, in which the lack of higher rotational symmetry at least partly results from a variation, across the cross-section of the fibre, in the material contained in the holes.

15. A photonic crystal fibre as claimed in any preceding claim, in which the lack of higher rotational symmetry at least partly results from a variation, across the cross-section of the fibre, in the shape of the holes.

16. A photonic crystal fibre as claimed in claim 15, in which the shape variation is due to deformation resulting from stresses in the fibre as it is drawn.

SUB B3 17. A photonic crystal fibre as claimed in any preceding claim, in which the lack of higher rotational symmetry results from a variation across the cross-section of the fibre, in one of the following in combination with one or more of the following or with a variation in another parameter: the microstructure of the core, the diameter of the holes, the bulk material, the material contained in the holes, the shape of the holes.

18. A photonic crystal fibre as claimed in any preceding claim, in which the birefringent fibre has form birefringence.

19. A photonic crystal fibre as claimed in any preceding claim, in which the birefringent fibre has stress birefringence.

20. A method of producing a birefringent photonic crystal fibre, the method comprising the following steps:

(a) forming a stack of canes, at least some of which are capillaries, the stack including canes arranged to form a core region in the fibre and canes arranged to form a cladding region in the fibre; and

(b) drawing the stack of canes into a birefringent fibre which has at-most-two-fold rotational symmetry about any longitudinal axis.

21. A method as claimed in claim 20, in which the stack of canes is arranged to have at-most-two-fold rotational symmetry about a longitudinal axis of the stack.

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22. A method as claimed in claim 20 or 21, in which the lack of higher rotational symmetry at least partly results from variations, across the cross-section of the stack, in the internal diameters of the capillaries.

23. A method as claimed in any of claims 20 to 22, in which the lack of higher rotational symmetry at least partly results from variations, across the cross-section of the stack, in the material of which the canes are made.

24. A method as claimed in any of claims 20 to 23, in which the lack of higher rotational symmetry at least partly results from variations, across the cross-section of the stack, in the material with which the capillaries are filled.

25. A method as claimed in any of claims 20 to 24, in which the lack of higher rotational symmetry at least partly results from variations, across the cross-section of the stack, in the external diameter of the canes.

26. A method as claimed in any of claims 20 to 25, in which canes are provided at the vertices of a cladding lattice which has at-most-two-fold rotational symmetry about the centre of the canes arranged to form the core.

27. A method as claimed in any of claims 20 to 25, in which capillaries of selected internal diameters are provided at the vertices of a cladding lattice which has at-most-two-fold rotational symmetry

about the centre of the canes arranged form the core, the selected internal diameters of the capillaries at the vertices of the cladding lattice being different from the internal diameters of the capillaries at other sites.

SUB B4 cont'D.

28. A method as claimed in any of claims 20 to 27, in which a substantial number of cladding canes, near to the canes arranged to form the core, are different from a substantial number of cladding canes, far from the canes arranged to form the core.

29. A method as claimed in any of claims 20 to 28, in which the birefringence results at least partly from stresses formed within the fibre as it is drawn.

30. A method as claimed in claim 29, in which the stress is introduced by the inclusion, at sites having at-most-two-fold rotational symmetry, of a cane made from a different material from that of which at least some of the other canes in the lattice are made.

31. A method as claimed in claim 29, in which the stress is introduced by the inclusion, at sites having at-most-two-fold rotational symmetry, of capillaries having a different capillary wall thickness from that of at least some of the other capillaries.

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32. A method as claimed in any of claims 29 to 31 in which the stresses result in the deformation of holes surrounding the core of the drawn fibre and that deformation results in birefringence.

33. A method as claimed in any of claims 29 to 31 in which the stresses result in stresses in the core

of the drawn fibre, and those stresses result in birefringence.

Sub B5 contd.

34. A method as claimed in any of claims 20 to 33, in which the lack of rotational symmetry at least partly results from pressurisation of at least one of the capillaries during the drawing of the stack.

35. A method as claimed in any of claims 20 to 34, in which the lack of rotational symmetry at least partly results from evacuation of at least one of the capillaries during the drawing of the stack.

36. A method as claimed in any of claims 20 to 35, in which the rotational symmetry of the stack of canes is two-fold rotational symmetry.

37. A method of producing a photonic crystal fibre, comprising:

(a) providing a plurality of elongate canes, each having a longitudinal axis, a first end and a second end, at least some of the canes being capillaries each having a hole parallel to the longitudinal axis of the cane and running from the first end of the cane to the second end of the cane;

(b) forming the canes into a stack, the canes being arranged with their longitudinal axes substantially parallel to each other and to the longitudinal axis of the stack;

(c) drawing the stack into a fibre whilst maintaining the hole of at least one capillary in communication with a source of fluid at a first pressure whilst maintaining the pressure around the capillary at a second pressure that is different from the first pressure, wherein the hole at the first

pressure becomes, during the drawing process, a size different from that which it would have become without the pressure difference.

38. A method as claimed in claim 27, in which a tube surrounds the stack of canes over at least a part of their length and the inside of the tube is maintained at the second pressure.

39. A method as claimed in claim 38, in which the tube restricts the expansion of at least one of the holes at the first internal pressure.

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40. A method as claimed in any of claims 37 to 39, in which the tube does not undergo deformation significantly different from that which it would undergo without the pressure difference.

41. A method as claimed in any of claims 37 to 40, in which, during the drawing process:

the tube is sealed near to the first end to a first end of an evacuatable structure and the second end of the tube is within the evacuatable structure;

at least some of the capillaries pass through the evacuatable structure and are sealed to a second end thereof;

and the evacuatable structure is substantially evacuated in order to produce the second internal pressure.

42. A method as claimed in claim 41, in which the evacuatable structure is a metal tube.

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43. A method as claimed in any of claims 37 to 42, in which the stack of canes has at-most-two-fold rotational symmetry about any of the longitudinal axes.